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UNITED STATES PATENT APPLICATION

of

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for new and useful invention entitled:

**ELECTRICAL CONNECTOR FOR CONNECTION BETWEEN COIL AND
PRINTED CIRCUIT BOARD IN AUTOMOTIVE ANTI-LOCK BRAKING SYSTEM**

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ELECTRICAL CONNECTOR FOR CONNECTION BETWEEN COIL AND
PRINTED CIRCUIT BOARD IN AUTOMOTIVE ANTI-LOCK BRAKING
SYSTEM

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Field of the Invention

The present invention relates to automotive anti-lock braking systems. More particularly, the present invention relates to electrical connectors for use in such automotive anti-lock braking systems.

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Background

In an automotive anti-lock braking system (ABS), wheel-speed sensors monitor the motion of the wheels. If one of the wheels begins to lock, the peripheral wheel deceleration and wheel slip increase sharply. When these quantities exceed certain thresholds, a controller circuit, typically mounted on a printed circuit board (PCB), commands a solenoid-valve unit to stop or reduce the buildup of wheel-brake pressure until a lock up condition is no longer imminent. To alleviate pressure buildup, the solenoid rapidly actuates the brakes in a "pumping" action that causes the wheel-brake pressure to undergo a succession of buildup, reduction, and holding phases.

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Inductive coils in the solenoid-valve unit are typically connected to the PCB by solder joints. The coils are connected to the valve block that houses the solenoid-valve unit through a mechanical interface. Various tolerances must be accommodated in conventional mechanical interfaces, increasing their design complexity and manufacturing cost.

Summary of the Invention

A coil bobbin has one or more protruding stems wrapped with a pre-tinned portion of a coil wire, such that the pre-tinned portion contacts the through-holes of the printed circuit board (PCB) when the stems are inserted through them.

- 5 Sufficient interference between the through-holes and the connector creates a tin-tin type connection system. The design complexity of the connector is reduced, and the need to solder the connector to the PCB is eliminated.

- According to one embodiment, an electrical connector for establishing a solderless connection between a solenoid wire coil and a printed circuit board for
10 use in an automotive anti-lock braking system includes a coil bobbin having at least one stem extending from a first surface thereof. A wire is wound in a coil arrangement around the coil bobbin and has a pre-tinned portion disposed over a distal end of the at least one stem.

- In another embodiment, the electrical connector comprises a coil
15 bobbin having a plurality of plastic stems extending from a first surface thereof. A wire is wound in a coil arrangement around the coil bobbin and has pre-tinned portions disposed over distal ends of each of the plastic stems. A secondary bobbin is formed over the wire, and a multi-lip wire seal is formed over the secondary bobbin for sealing the wire.

- 20 The above summary of the present invention is not intended to describe each illustrated embodiment or every implementation of the present invention. The figures and the detailed description that follow more particularly exemplify these embodiments.

Brief Description of the Drawings

These and other aspects and advantages of the present invention will become apparent upon reading the following detailed description and upon reference to the drawings, in which:

5 FIG. 1 illustrates an example electrical connector for connecting a solenoid coil to a printed circuit board, according to an embodiment of the present invention;

FIG. 2 is a magnified view of a portion of the electrical connector depicted in FIG. 1; and

10 FIG. 3 is a cross-sectional view of a portion of the electrical connector depicted in FIGS. 1 and 2.

CS
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CS
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The invention is amenable to various modifications and alternative forms. Specifics thereof have been shown by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not
PJ
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15 to limit the invention to the particular embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

Detailed Description

20 The present invention is applicable to a variety of automotive anti-lock braking (ABS) systems. The invention has been found to be particularly advantageous in environments in which a simple interface between a solenoid coil and control circuitry disposed on a printed circuit board (PCB) is desirable. An

appreciation of various aspects of the invention can be gained through a discussion of various application examples operating in such environments.

According to one embodiment of the present invention, a coil bobbin has one or more protruding stems wrapped with a pre-tinned coil wire. The coil wire contacts the through-hole of the PCB. Sufficient interference between the through-hole and the connector creates a tin-tin type connection system. The design complexity of the connector is reduced, and the need to solder the connector to the PCB is eliminated.

Referring now to the figures, FIG. 1 depicts an example electrical connector 100 for connecting the solenoid coil to the PCB, according to a particular embodiment of the present invention. A coil bobbin 102 provides the main structure for the connector 100. A coil wire 104 is wrapped around the coil bobbin 102. A portion of the coil wire 104 is pre-tinned and passes through holes 106 in the top surface of the coil bobbin 102. The pre-tinned portion is then wrapped over plastic stems 108 that protrude from the top of the coil bobbin 102.

One of the plastic stems 108 is illustrated in greater detail in FIG. 2 and in cross-sectional view in FIG. 3. The plastic stem 108 has an end portion 110 over which a pre-tinned portion 112 of the coil wire 104 of FIG. 1 is wrapped. FIG. 2 shows this end portion 110 inserted through a plated through-hole of a PCB 114. Wrapping the pre-tinned portion 112 of the coil wire 104 over the end portion 110 allows a connection to be established between the coil wire 104 and the PCB 114 when the end portion 110 of the plastic stem 108 is inserted through the through-hole. According to a particular implementation, an optional secondary bobbin 116 is molded over the coil wire 104 and the coil bobbin 102. An optional multi-lip wire

seal 118 is then formed over the secondary bobbin 116 to seal the coil wire 104 from the plastic electronic control module housing. Alternatively, the coil wire 104 can be sealed using a different technique, such as, for example, an O-ring or silica gel.

By wrapping the coil wire over the plastic stem as described above, a
5 connection can be established between the coil wire and the PCB without soldering. As a result, the interface between the coil and the solenoid valve block is simplified, reducing manufacturing costs.

The various embodiments described above are provided by way of illustration only and should not be construed to limit the invention. Those skilled in
10 the art will readily recognize various modifications and changes that can be made to these embodiments without strictly following the example embodiments and applications illustrated and described herein, and without departing from the true spirit and scope of the present invention, which is set forth in the following claims.